PHYSICS

PHYSICS : The branch of science concerned with the nature and properties of matter and energy. The subject matter of physics includes mechanics, heat, light and other radiation, sound, electricity, magnetism, and the structure of atoms.

Light reflection and refraction

A.1 Reflection of light
A.2 Spherical mirrors: Formation of image
A.3 Uses of spherical mirrors
A.4 Mirror formula and magnification
A.5 Refraction of light
A.6 Refraction by spherical lenses
A.7 Lens formula and magnification – Power of lens

Human eye and colorful world

B.1 The human eye
B.2 Power of accommodation
B.3 Why do we have two eyes
B.4 Defects of vision and its correction: myopia
B.5 Defects of vision and its correction: Hypermetropia
B.6 Defects of vision and its correction: Presbyopia
B.7 Defects of vision and its correction: Astigmatism
B.8 Refraction of light through prism
B.9 Dispersion of white light through glass prism
B.10 Atmospheric refraction
B.11 Scattering of light

Electricity

C.1 Electric current and circuits
C.2 Electric potential and potential difference
C.3 Circuit diagram
C.4 Ohm’s law
C.5 Factors on which the resistance of conductor depends
C.6 Resistance of a system of resistors
C.7 Heating effect of electric current
C.8 Electric power

Magnetic effect of electric current

D.1 Magnetic field and field lines
D.2 Magnetic field due to current carrying conductors
D.3 Force on current carrying conductor in electric field
D.4 Electric motor
D.5 Electromagnetic induction
D.6 Domestic electric circuits

Sources of energy

E.1 What is a good source of energy
E.2 Conventional sources of energy: fossil fuels
E.3 Conventional sources of energy: Hydro power plant
E.4 Alternate or non- conventional sources of energy: Biomass bio-gas
E.5 Non Conventional Sources of Energy -Ocean Thermal Energy
E.6 Non Conventional Sources of Energy -Solar Energy – Photo voltaic Cell
E.7 Non Conventional Sources of Energy – Tidal Energy
E.8 Non Conventional Sources of Energy – Geothermal Energy
E.9 Non Conventional Sources of Energy – Ocean Thermal Energy
E.10 Environmental consequences
E.11 How long will an energy source last us

Management of Natural Resources

F.1 Save the Environment from Environmental Pollution – Reuse
F.2 Save the Environment from Environmental Pollution – Reduce
F.3 Save the Environment from Environmental Pollution – Recycle
F.4 Why do we need to manage our natural resources
F.5 Forest and wildlife
F.6 Sustainable management
F.7 Water for all : dam
F.8 Water harvesting
F.9 Coal and petroleum

Unit 1
LIGHT : REFLECTION & REFRACTION

LIGHT: REFLECTION AND REFRACTION

- "Light is an electromagnetic ray that travels in a straight line"
- Reflection of Light:
  - When light falls on a surface and is reflected back into the same medium, we say reflection has taken place
- Refraction of Light:
  - When light travels from one medium to another it bends from its original path
  - This phenomenon is called refraction.

Nature of Light

Light behaves as a:

- ray, e.g. reflection
- wave, e.g. interference and diffraction
- particle, e.g. photoelectric effect

Light incident on another medium

When light travels from one medium to another medium it either:

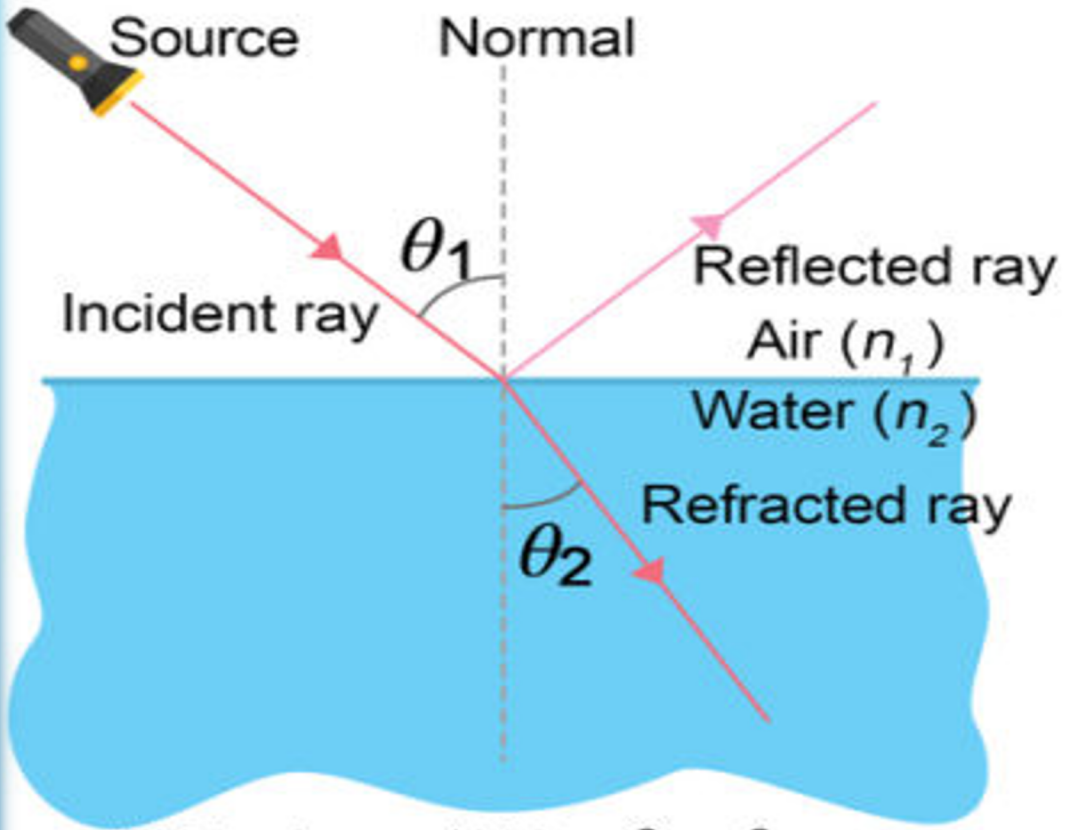
- gets absorbed (absorption)
- bounces back (reflection)
- passes through or bends (refraction)

When light is incident on a plane mirror, most of it gets reflected, and some of it gets absorbed in the medium.

REFLECTION OF LIGHT

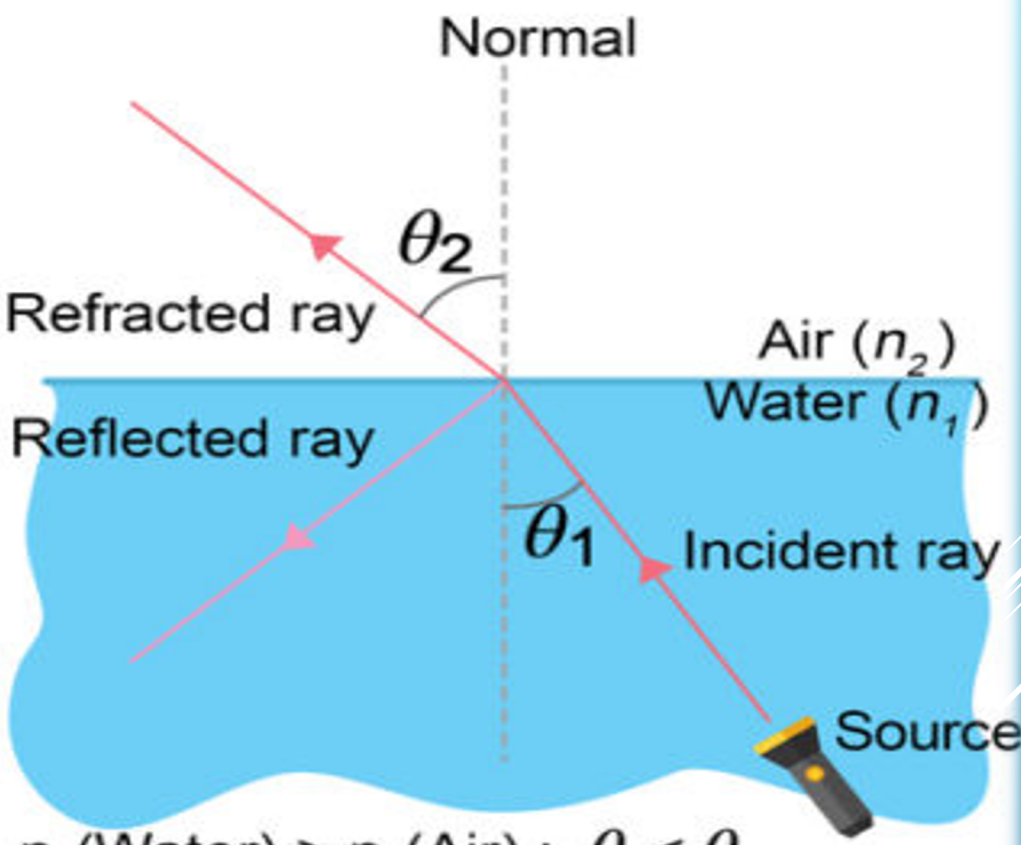
TERMS RELATED TO REFRACTION OF LIGHT

- **Incident Ray**: The ray of light that falls on the reflecting surface
- **Reflected Ray**: The ray of light that is sent back by the reflecting surface
- **Normal**: The normal is a line at right angle to the reflecting surface to the point of incidence
- **Angle of Incidence**: It is the angle made by the incident ray and the normal



n_2(Water) > n_1(Air) ; $\theta_1 > \theta_2$

Rays bend towards perpendicular

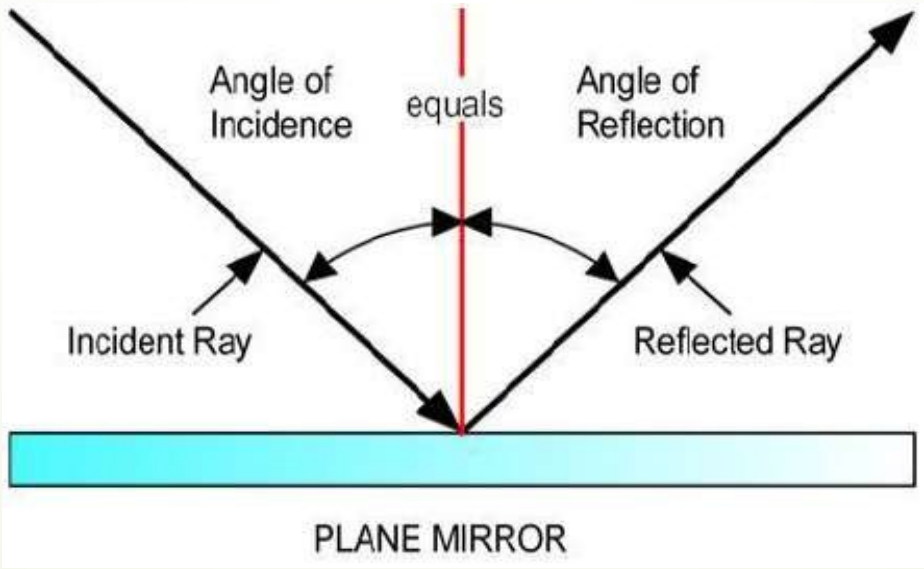


n_1(Water) > n_2(Air) ; $\theta_1 < \theta_2$

Rays bend away from perpendicular

LAWS OF REFLECTION OF LIGHT

- **Laws of Reflection of light are:**
  - The angle of incidence is equal to the angle of reflection
  - The incident ray, the reflected ray and the normal to the mirror at the point of incidence all lie in the same plane
  - The incident ray and the reflected ray lie on either side of the normal



IMAGE

In optics, an **image** is defined as the collection of focus points of light rays coming from an object. A real **image** is the collection of focus points actually made by converging rays, while a virtual **image** is the collection of focus points made by extensions of diverging rays.

Characteristics of images

- Images can be real or virtual, erect or inverted, magnified or diminished. A real image is formed by the actual convergence of light rays. A virtual image is the apparent convergence of diverging light rays.
- If an image formed is upside down then it is called inverted or else it is an erect image. If the image formed is bigger than the object, then it is called magnified. If the image formed is smaller than the object, then it is diminished.

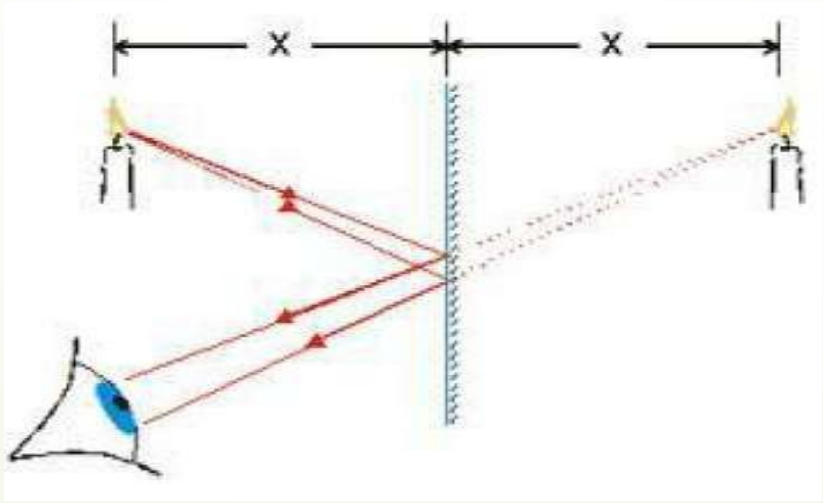
PROPERTIES OF IMAGE FORMED BY A PLANE MIRROR

Plane mirror

Any flat and polished surface that has almost no irregularities on its surface that reflect light is called as a plane mirror.

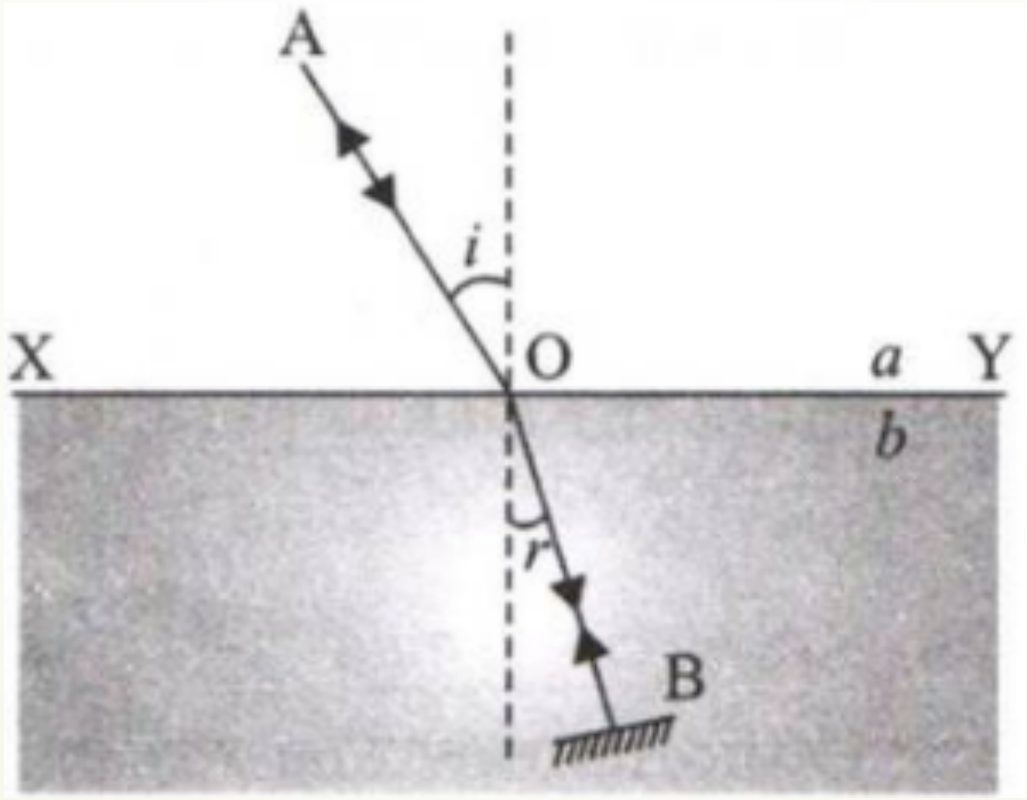
- **The image formed in a plane is mirror is…**

1. Virtual and Erect
2. Of the same size as of the object
3. At the same distance from the mirror as the object is in front of it
4. Laterally inverted



Principle of Reversibility of light

If the direction of a ray of light is reversed due to reflection off a surface, then it will retrace its path.



SPHERICAL MIRRORS: CONCAVE AND CONVEX

Spherical mirror

Consider a hollow sphere with a very smooth and polished inside surface and an outer surface with a coating of mercury so that no light can come out. Then if we cut a thin slice out of the shell, we get a curved mirror, which is called a spherical mirror.

- **Concave Mirror**: A spherical mirror that has its reflecting surface curved inwards
- **Convex Mirror**: A spherical mirror that has its reflecting surface curved outwards

Relationship between focus and radius of curvature

Focal length is half the distance between pole and radius of curvature.

F = R/2

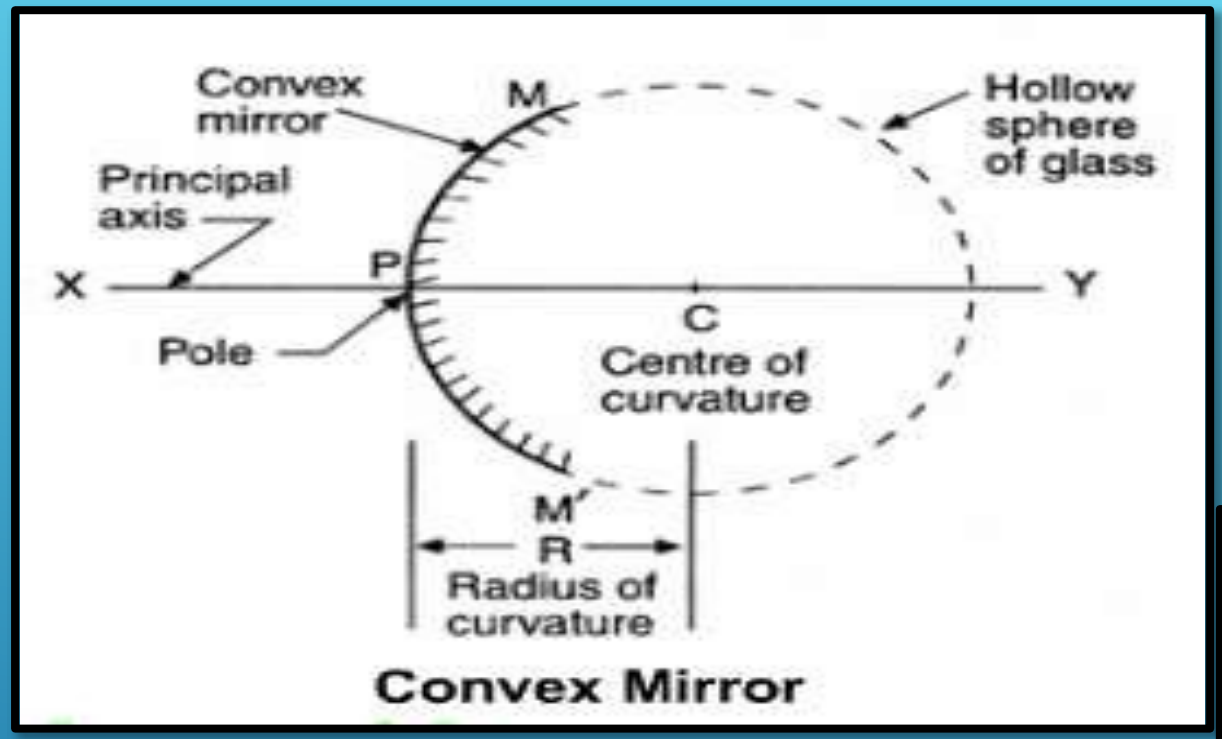
Rules of ray diagram for representation of images formed

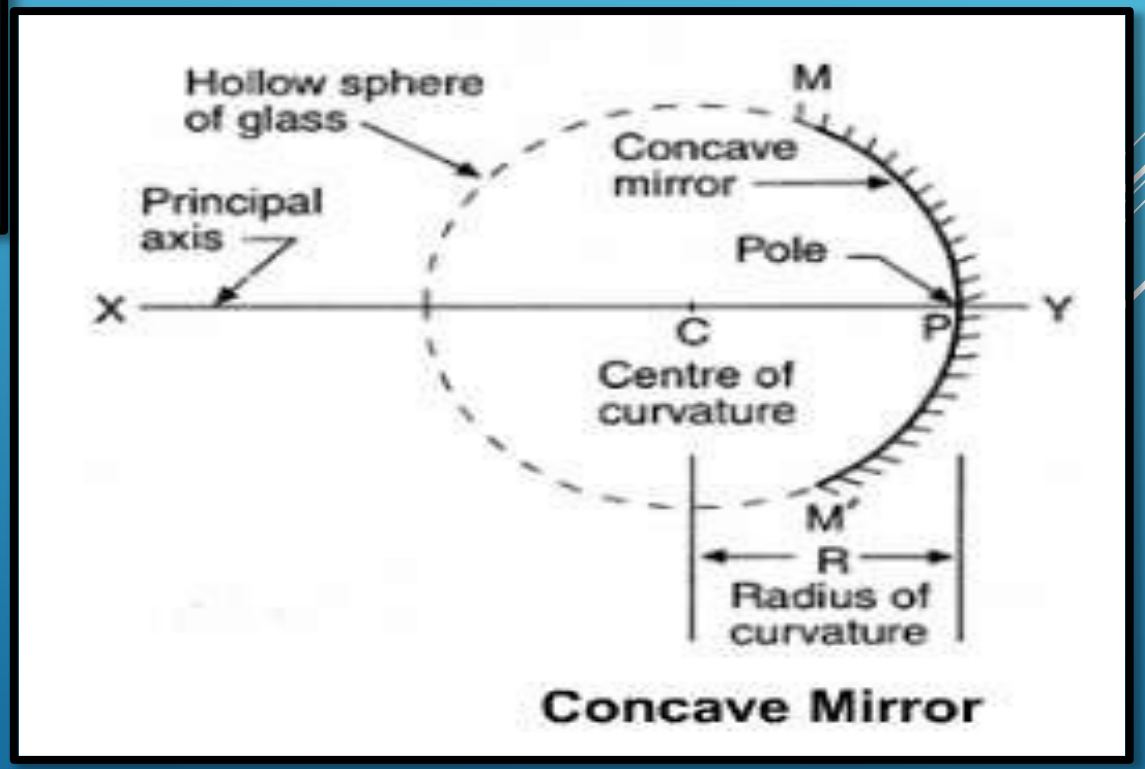
• A ray passing through the centre of curvature hits the concave spherical mirror and retraces its path.

•Rays parallel to the principal axis passes through the focal point or focus.

TERMS USED TO EXPLAIN SPHERICAL MIRRORS

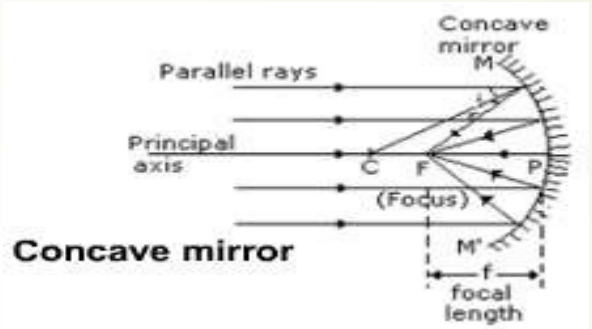
- Pole (P): The midpoint of a spherical mirror.
- Centre of curvature (C): The centre of the sphere that the spherical mirror was a part of.
- The radius of curvature (r): The distance between the centre of curvature and the spherical mirror. This radius will intersect the mirror at the pole (P).
- Principal Axis: The line passing through the pole and the centre of curvature is the main or principal axis.
- Concave Mirror: A spherical mirror with the reflecting surface that bulges inwards.
- Convex Mirror: A spherical mirror with the reflecting surface that bulges outwards.
- Focus (F): Take a concave mirror. All rays parallel to the principal axis converge at a point between the pole and the centre of curvature. This point is called as the focal point or focus.
- Focal length: Distance between pole and focus.


Convex mirror
M
Hollow sphere of glass
Principal axis
X
P
Y
C
Pole
Centre of curvature
M'
R
Radius of curvature
Convex Mirror

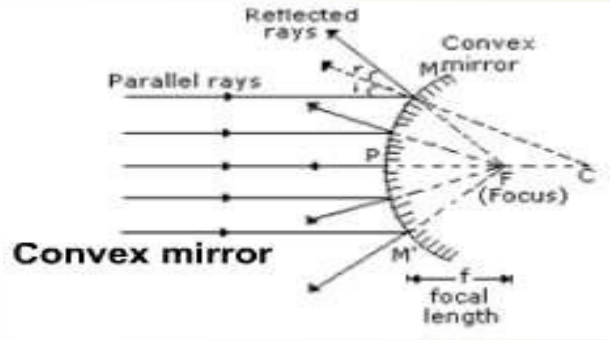

Hollow sphere of glass
M
Concave mirror
Principal axis
Pole
X
C
P
Y
Centre of curvature
M'
R
Radius of curvature
Concave Mirror

FOCUS AND FOCAL LENGTH OF SPHERICAL MIRRORS

- **Principal Focus:**
  - Focus of Concave Mirror: It is a point on the principal axis, where all the rays parallel to the principal axis converge



  - Focus of Convex Mirror: It is a point on the principal axis, where the reflected rays appear to converge

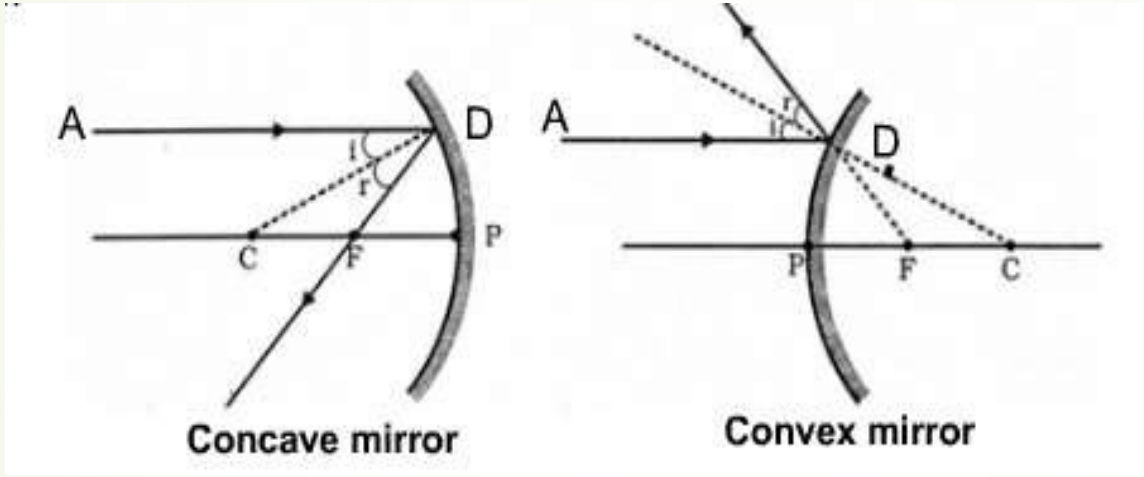


- **Focal length of Spherical Mirrors:**
  - The distance between the pole and the principal focus is called the focal length of the spherical mirror

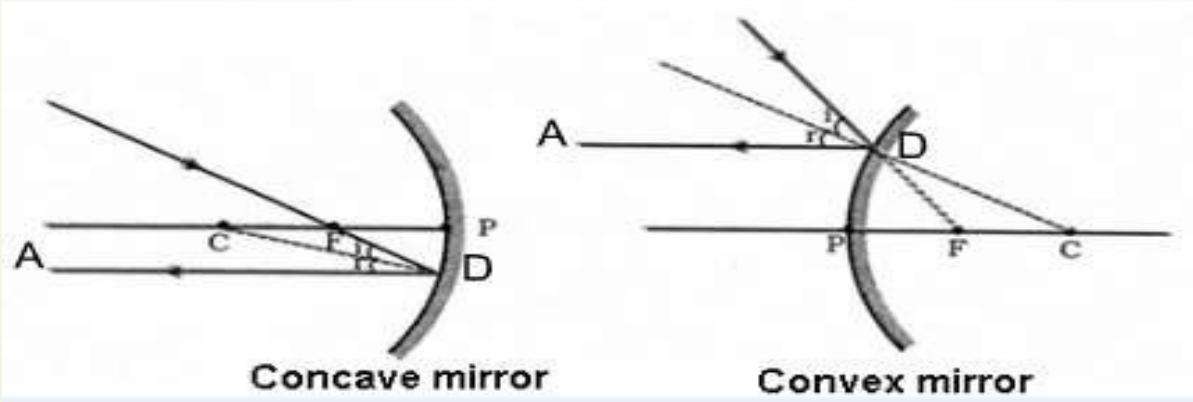
- The Radius of Curvature is two times the Focal Length of any spherical mirror

RULES FOR REFLECTION OF LIGHT THROUGH SPHERICAL MIRRORS

- If in a concave mirror, a ray of light parallel to the principal axis after reflection will pass through the focus or appear to diverge from the focus in case of convex mirror

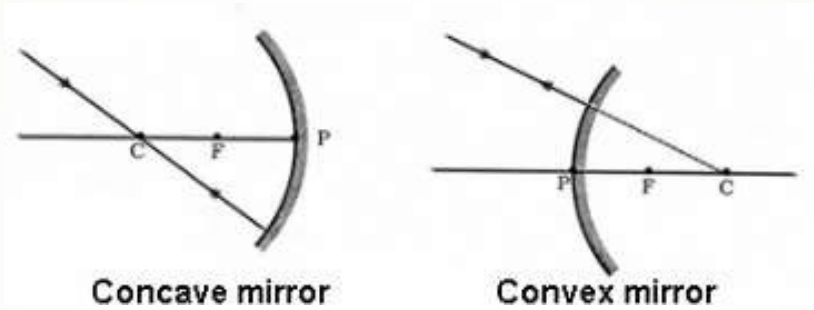


- A ray passing through the focus of a concave mirror, after reflection, will emerge parallel to the principal axis

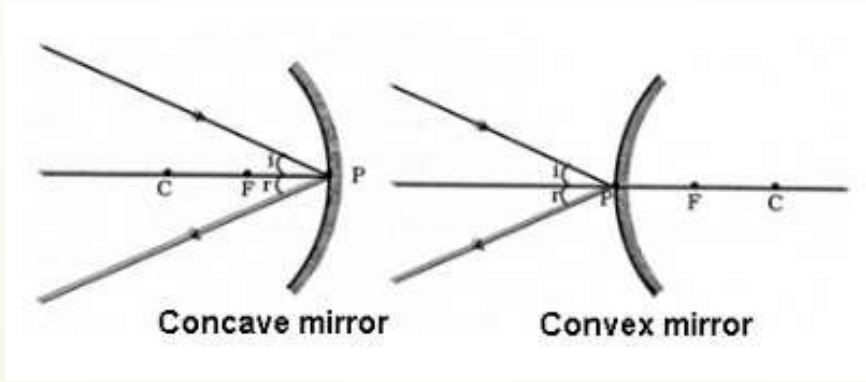


RULES FOR REFLECTION OF LIGHT THROUGH SPHERICAL MIRRORS

- A ray passing through the centre of curvature, after reflection is reflected back along the same path



- A ray incident obliquely to the principal axis towards the pole on the spherical mirrors is reflected back obliquely



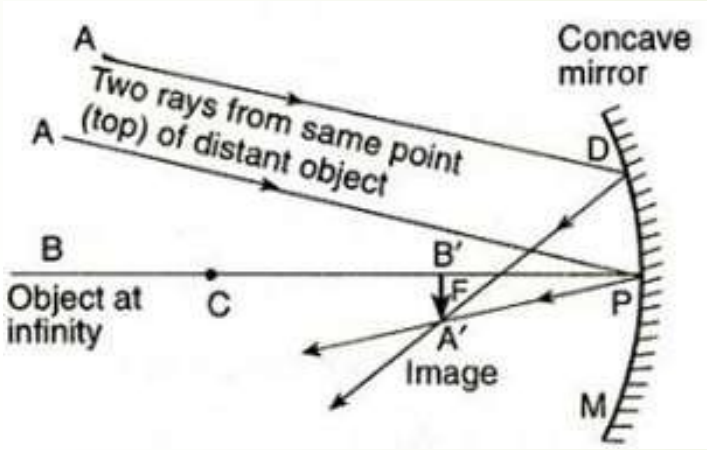
FORMATION OF DIFFERENT TYPES OF IMAGES BY CONCAVE MIRRORS

- We can place the object at six positions from the mirror:
  - At infinity
  - Beyond C
  - At C
  - Between C and F
  - At F
  - Between F and P

FORMATION OF DIFFERENT TYPES OF IMAGES BY CONCAVE MIRRORS

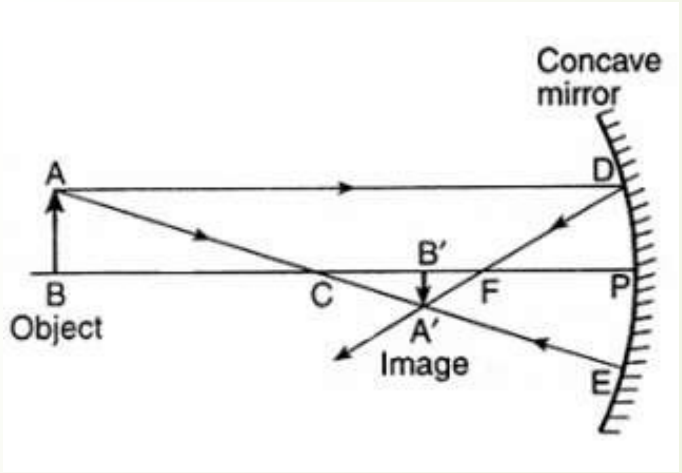
1. At infinity:

- The image formed is:
  - Real and Inverted
  - Highly diminished, Point-sized
  - Formed at F



2. Beyond C:

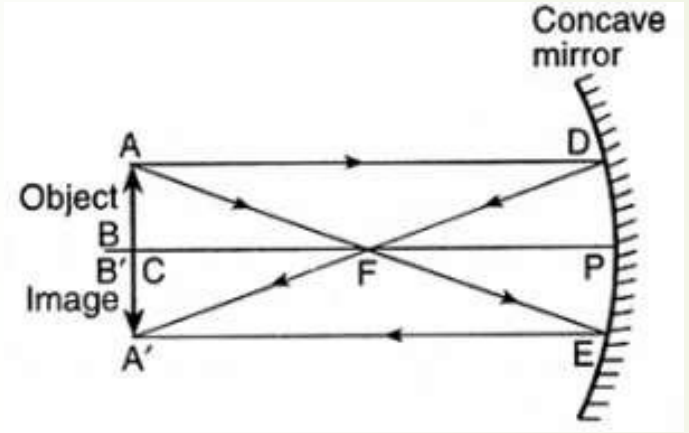
- The image formed is:
  - Real and Inverted
  - Between F and C
  - Diminished



FORMATION OF DIFFERENT TYPES OF IMAGES BY CONCAVE MIRRORS

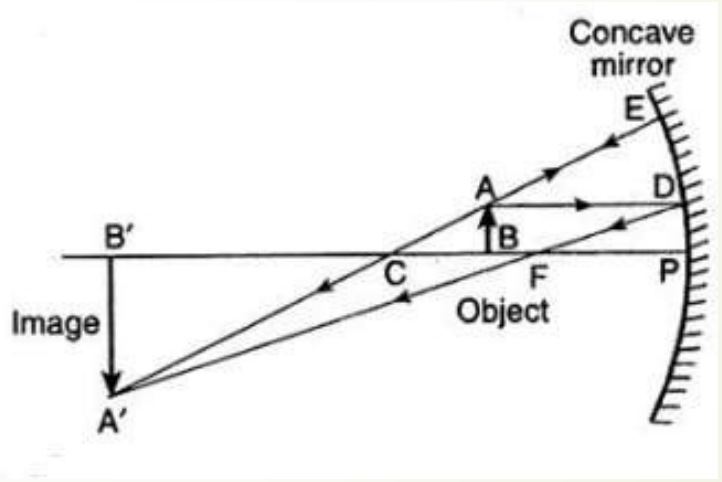
3. At C:

- The image formed is:
  - Real and Inverted
  - At C
  - Of the same size as the object



4. Between F and C:

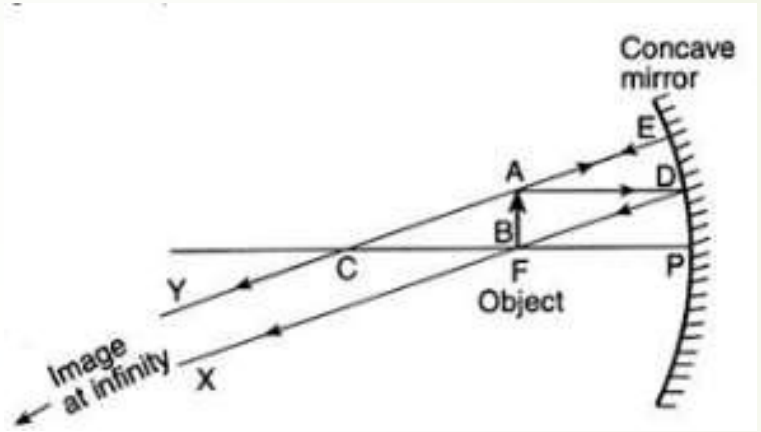
- The image formed is
  - Real and Inverted
  - Beyond C
  - Magnified



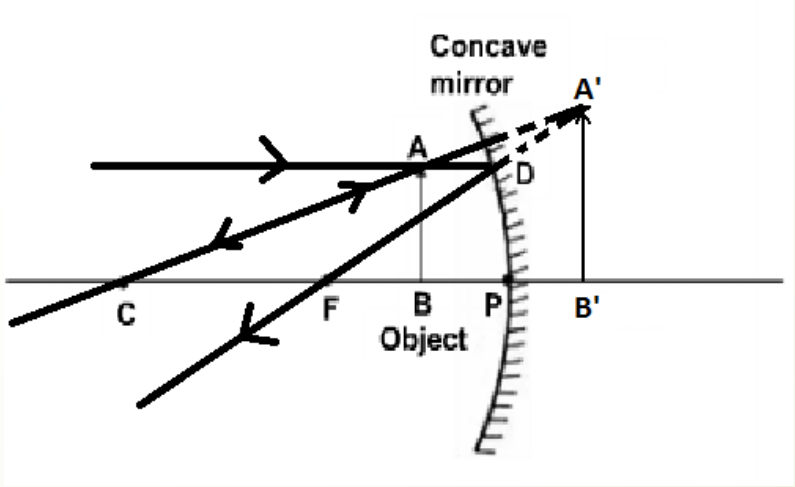
FORMATION OF DIFFERENT TYPES OF IMAGES BY CONCAVE MIRRORS

5. At F:

- The image formed is:
  - Real and Inverted
  - At infinity
  - Highly magnified



6. Between F and P:
   - Virtual and Erect
   - Behind the mirror
   - Magnified



FORMATION OF DIFFERENT TYPES OF IMAGES BY CONCAVE MIRRORS

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

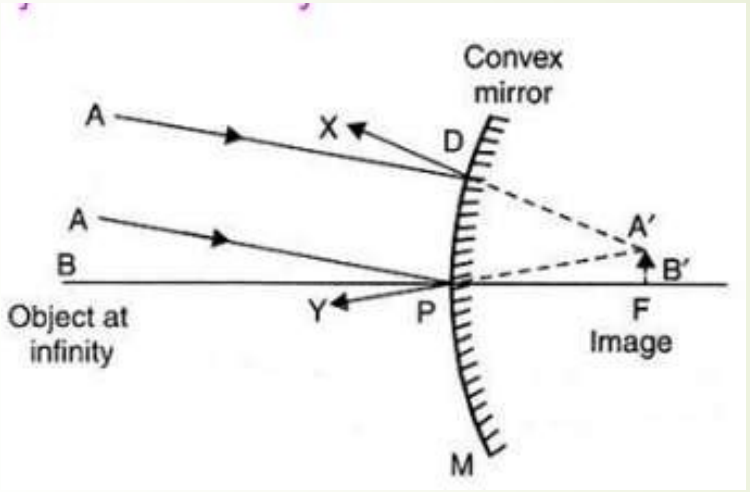
USES OF CONCAVE MIRRORS

- Concave mirrors are used as:
  - Shaving mirrors
  - Torches, search lights, and vehicle headlights
  - Used by dentist to get large images of patient's teeth
  - In solar furnaces to concentrate heat

IMAGE FORMATION BY CONVEX MIRROR

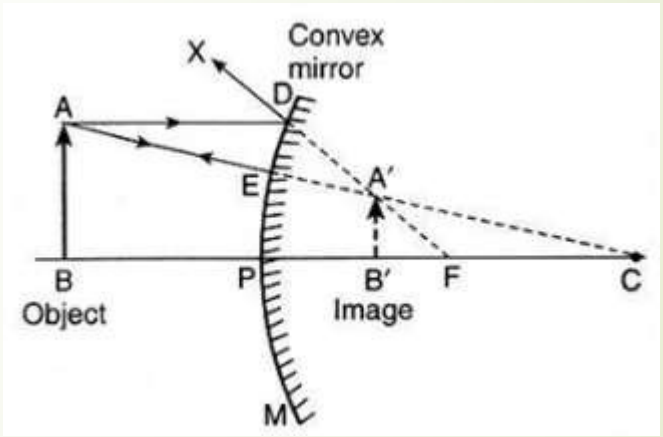
1. At Infinity:

- The image formed is
  - Virtual and Erect
  - Behind the mirror (at F)
  - Highly diminished



2. Between Infinity and P:

- The image formed is:
  - Virtual and Erect
  - Behind the mirror (between P and F)
  - Diminished

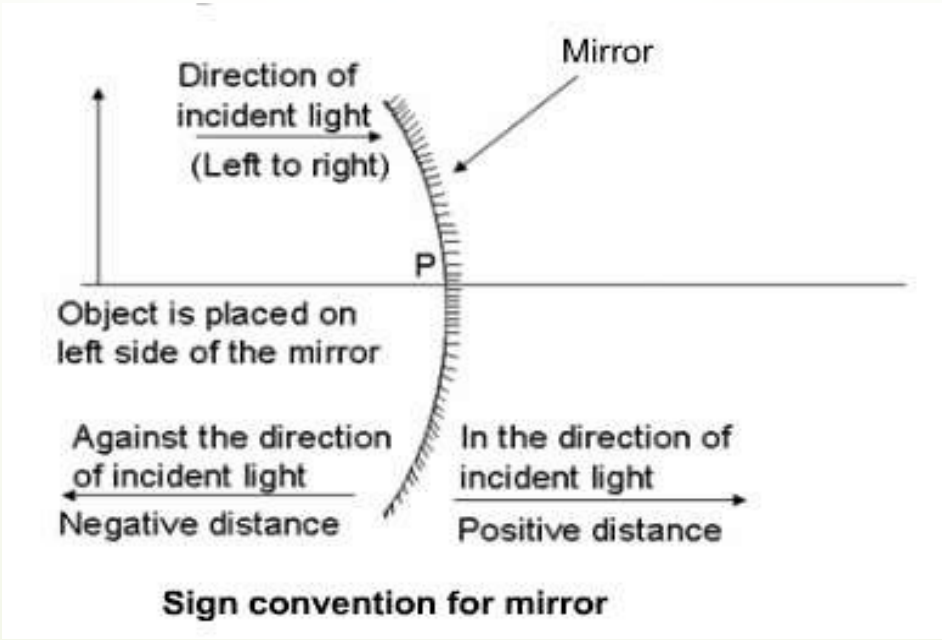


USES OF CONVEX MIRRORS

- Convex mirrors are used in:
  - Vehicles as rear-view mirrors to see traffic at the rear-side
  - Used as a device to check thefts in shops

NEW CARTESIAN SIGN CONVENTION

- Object is placed left to the mirror and the pole is taken as the origin
- Distance to the right of origin **(+ve X-axis)** is positive while that to its left **(-ve X-axis)** is negative
- Distances above the principal axis **(+ve Y-axis)** are positive while those below it **(-ve Y-axis)** are negative



Sign convention for mirror

MIRROR FORMULA FOR SPHERICAL MIRRORS

- The mirror formula is:

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

Where, **u**= Object distance

v= Image distance

f= Focal length

	Convex Mirror	Concave Mirror
u	Negative	Negative
v	positive	Positive or Negative
f	positive	Negative

MAGNIFICATION

$$Magnification\ (m) = \frac{height\ of\ image\ (h_2)}{height\ of\ object\ (h_1)} = \frac{-Image\ distance\ (-v)}{Object\ distance\ (u)}$$

- For Virtual image, ***m*** is positive
  Real image, ***m*** is negative

- If **m>1**, image is bigger than the object
- If **m=1**, image is of the same size as of the object
- If **m<1**, image is smaller than the object

- If ***m*** is positive, then the image is virtual and erect
- If ***m*** is negative, then the image is real and inverted